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AQUEOUS LEAF EXTRACTS ALLELOPATHIC EFFECT OF TECTONA GRANDIS ON SEEDLING GROWTH OF VIGNA MUNGO AND VIGNA RADIATA

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ABSTRACT

Allelopathy plays a vital role both in natural and managed ecosystems.Eventhough allelopathy includes both positive and negative effects of one plant on the other,most of the studies seems to focus only on its deleterious impacts alone. *Tectona grandis*(Teak) is the most valuable timber of the world and indigenous to Burma,India and Thailand under social forest scheme.Also introduced in Thanjavoor district on the banks of rivers,streams and ponds. This experiment was conducted in order to evaluate the allelopathic effects of the aqueous extract (A.E.) of *Tectona grandis* Linn.f. on the seedling growth in *Vigna mungo*(Black gram) and *Vigna radiata* (Green gram) . For this present study the seeds of *Vigna mungo* (Black gram)Var.ADT-3. and *Vigna radiata*(Green gram)Var.Co.3.were selected. Dried fallen leaves were collected from coastle area of Cuddalore District.The sterilized fifty seeds were placed in petridishes containing different concentrations of teak leaf extract(0,5,10,25,50,75 and100%).The dry weight of both crops *Vigna mungo* and *Vigna radiata* were increased in 5% concentrated treatment. All other concentrations showed a decreased dry weight and very low dry weight were observed in 100% treated seedlings. Results showed that low concentrations of *T.grandis* dry leaves Allelopathic Effect(A.E.) had significant promotary effect on the Black gram and Green gram seedlings growth.The higher applied concentration from aqueous extracts of *T.grandis* was completely inhibited *Vigna mungo* and *Vigna radiata* seedling seedling growth by 100%, at 50 g compared to its control. However, treatments with higher concentrations had negative effects on rate of seedling growth. Low concentration increase the seedling growth increase in both crop seedlings shows promontory effect. As the concentration of *T.grandis* extract increased seedling growth of black gram and green gram decrease shows inhibitory effect.

Keywords: Allelochemicals, Allelopathic effect, Root length, Shoot length, , Tectona grandis, vignamungo, vigna radiata.

INTRODUCTION

Teak (*Tectona grandis*), large deciduous tree of the family Verbenaceae, or its wood, one of the most valuable timbers. Teak has been widely used in India for more than 2,000 years. The name *teak* is from the Malayalam word *tekka*. Tree reaching over 30 m in height in favourable conditions. *Tectona grandis* grows best in a warm, tropical climate with a temperature above 22 ºC. Teak prefers well-drained, fertile soils and is a strong light demander. Trees are 96 to 100% self-incompatible. The timber is used for ship decking, flooring, furniture and construction. It is particularly recommended for

construction in seaside environments (such as bridges and docks) because it is resistant to shipworm, a wood-boring sea mollusc (*Teredo* spp., Teredinidae). 4-sided leaves are shed for 3-4 months during the later half of the dry season, leaving the branchlets bare. Shiny above, hairy below, vein network clear, about 30 x 20 cm but young leaves up to 1 m long. The leaves are opposite or sometimes whorled in young specimens, about 0.5 metre (1.5 feet) long and 23 cm (9 inches) wide. In shape they resemble those of the tobacco plant, but their substance is hard and the surface rough. During the dry season the tree is leafless; in hot localities the leaves fall in January, but in moist places the tree remains green until March. At the end of the dry season, when the first monsoon rains fall, the new foliage emerges. In India it was found that teak plantations with groundnut and soybean were very successful (Mishra and Prasad, 1980). However, later studies showed that leaves of *T.grandis* had allelopathic effect on several crop plants. In 1996 The International Allelopathy Society defined allelopathy as follows: *"*Any process involving secondary metabolites produced by plants, micro-organisms, viruses, and fungi that influence the growth and development of agricultural and biological systems (excluding animals), including positive and negative effects" (Torres et al. 1996). Allelopathy is the direct influence of chemicals released from one plant on the development and growth of another plant (Mafeo *et al*, 2010).Allelopathy is the overall influence of one plant on another due to the chemical compounds being added to the environment(Muller,1996).

Allelopathy is believed to be involved in many natural and manipulated ecosystems and it plays an important role in the evolution of plant communities, exotic plants invasion and replant failure (Inderjit, 2003). Some authors have used the term in a more restricted sense to describe only the harmful effects of one higher plant upon another. Allelopathy occurring among individuals of the same species is termed autotoxicity. Allelopathy is fascinating and perplexing subject that concern with the interaction of plants as influenced by the chemical substances that they release into the environment (Machado, 2007). Many plant species including medicinal plants are able to produce and release bioactive compounds which are secondary metabolites into the environment and are capable of suppressing the growth of other plants. Such chemicals include tannins, phenolic acids, lignins, alkaloids, flavonoids, coumarins and terpenoids. They are present in all plant tissues including leaves, stems, roots, rhizomes, flowers, fruits and seeds, and even in pollen grains (Ahmad et al., 2011). Allelopathy is a complex phenomenon between phenolic compounds and concentration of allelochemicals. It has both inhibitory and stimulatory effects, which may be decided by concentration of allelochemicals present in extraction. Allelochmicals which inhibited the growth of some species at certain concentrations may stimulate the growth of same or different species at lower concentrations. Chemicals released from plants and imposing allelopathic influences are termed allelochemicals or allelochemics. Most allelochemicals are classified as secondary metabolites and are produced as offshoots of the primary metabolic pathways of the plant. some allelochemicals are known also to have structural functions (e.g. as intermediates of lignification) or to play a role in the general defence against herbivores and plant pathogens (e.g. Einhellig 1995). Allelochemicals when released to the soil, inhibit germination, shoot and root growth of other plants, affect nutrients uptake or naturally occurring symbiotic relationship, thereby destroying the plant's usable source of nutrients (Abu-Romman et al., 2010). .The effects of the presence of allelochemicals was not limited to germination inhibition alone, it also brings about impairment

in the metabolic activities of the targeted plants, leading to decrease in their root and shoot length (Abu-Romman et al., 2010). Several studies have been shown that allelopathic crops reduce growth and development of other crops growing simultaneously or subsequently in the fields (Fenandez *et al*, 2007; Oussama, 2003). *T. grandis* has also shown high allelopathic activity on *Triticum aestivum* (Krishna *et al.*, 2003).Interest in allelopathic studies in agroforestry systems is growing, because knowledge of these interations could provide powerful tools for the integrated in management of plagues and a better exploitation of natural resources anywhere in the world.We report here the allelopathic effect of *Tectona grandis* leaves extract on enzymes content of black gram and green gram were studied.

MATERIALS AND METHODS

The pulses of *Vigna mungo*(Black gram) and *Vigna radiata*(Green gram) have been selected for the present study. In this present investigation, the allelopathic effect of *Tectona grandis* Linn.f. on the germination of *Vigna mungo* and *Vigna radiata* were studied.All the experiments were conducted in the physiology laboratory of the Department of Botany,Annamalai University,Annamalai Nagar.

Collection of Donor plant material:

The dried leaf of *Tectona grandis* was collected as Donor plant, from the coastal area of Cuddalore district.Leaves were again dried and powdered with the help of willey machine at Chidambaram.

Collection of Recipient plant materials

The pulses seeds of *Vigna mungo*. L. And *Vigna radiata.* L. were procured from Tamilnadu Research Station, Aduthurai. Seeds with uniform size, colour and weight were selected and stored in metal tins as suggested by Rao(1976).

Pretreatment of seeds

Both *Vigna mungo* and *Vigna radiata* seeds used in the experiment were pre-cleaned and treated by using 0.1% mercuric chloride solution for 2-3 minutes.

Effect of aqueous extracts:

The 50g of *Tectona* dried leaf powder was soaked in 500ml of distilled water. After 24 hours, they were filtered with the help of Whatman No.1 filter paper and pure extracts of leaf were obtained. Using this stock solution, various concentration of extracts(0,5.10,25,50,75 and 100%) were prepared by using distilled water and used for the present study. These extracts were tested against *Vigna mungo and Vigna radiata* on 2-folds of filter paper in Petri dishes separately. The filter papers were moistened with the respective extracts or the distilled water as the case may be Germination, growth of plumule and radical were noted after 24 hours.

Petridish Technique and Sowing

The methods of seeds germination were carried out as recommended by International Seed Testing Association(1979). The seeds were thoroughly washed under tap water. Sterilized fifty seeds were arranged equi-specially in sterilized petri dish lined with filter paper. In each petri dish to uniform seeds were placed and irrigated. Each petri dish was irrigated uniformly by different concentration of *Tectona* leaf in the respective petri dishes. In addition to this, petri dishes containing seeds were irrigated with distilled water and maintained as control. Each treatment including control was replicated three times. The petri dishes were kept under light at room temperature(28±2°C)The number of seeds germinated in each treatment was counted daily starting from II nd day up to 10^{th} day after sowing for growth .

Root length

Root length was measured on eighth day from five randomly selected normal seedlings.

Average of five root length was calculated and expressed in centimeter.

Shoot length

The seedlings which were used for measuring root length were also used for measuring shoot length and mean was calculated and expressed in centimeter. The root and hypocotyl lengths were measured with a ruler.Percentages of growth inhibition of root and shoot lengths under the influence of the aqueous Tectona grandis leaf extract were calculated from the equation:

$$\text{Percentage} = \frac{T-C}{C} \times 100$$

where T=length of treatment organs (mm) and C=length of control organs (mm). The experiments were conducted using a randomized complete block design with three replications.

RESULTS

Results obtained from this present investigation of aqueous leaf extracts allelopathic effect of *Tectona grandis* on seedling growth of *Vigna mungo* and *Vigna radiata* were present in Table 1.From this results 5% leaf extract treatment shows stimulatory effect on both test crops.the inhibitory effect obtained in 100% treatment. From the results it is observed that in 5% leaf extract treated seedlings, in shoot length (20.24 ± 1.01),root length(6.34± 0.31) and leaf area(4.02 ± 0.20) *Vigna mungo* seedlings than control (20.14± 1.00),(5.22 ± 0.26) and (3.80± 0.19) respectively. Mishra *et al*,(2004) who stated that aqueous leachates up to 5 per cent concentration was found to be non toxic, further increase in concentration (10 per cent) significantly inhibited the germination and seedling length. Towata and Hongo (1987) tested mimosine for its allelopathic activity against rice, radish, turnip, kidney bean, and carrot. Radical growth was inhibited at 10 ppm concentration while growth of rice, radish, turnip and kidney bean was stimulated at 1ppm concentration. According to Jabeen & Ahmed (2009), the plants may exhibit inhibitory or rarely stimulatory effect on germination and growth of other plants in the immediate vicinity. From 10% concentration of extract increase this values decreased gradually upto 75% treatment.Very high inhibitory effects observed in 100% treatment of shoot(15.90 ± 0.79),root length (2.64± 0.13) and (0.44± 0.02) leaf area in *Vigna mungo* seedlings.Similar kind of Allelopathic Effects(AE) observed in 5% treatment of *Tectona* dry leaf extract in shoot(20.02±1.00),root length(4.68± 0.23) and leaf area(3.61± 0.18). Mubarak et al. (2009), who reported that the leaf water extract of some trees significantly increased hypocotyl and radicle length of maize.The inhibitory effect of 100% treated *Vigna radiata* seedlings exhibit more inhibitory effect in shoot,root length and leaf area (9.02 ± 0.45),(0.90 ± 0.04) and (0.19± 0.00) than control(19.90 ± 0.99),(4.84 ± 0.24) and(2.81 ± 0.14) respectively. Tawaha and Turk (2003) reported black mustard extracts reduced wild barley hypocotyl length, hypocotyl weight, radicle weight, seed germination, and radicle length by as much as 44, 55, 57, 63 and 75 %, respectively, when compared with a water control. The reduction pattern in seedling growth was highly similar to root length and leaf area of both crops growth.

DISCUSSION

Allelopathy is expected to be an important mechanism in the plant invasion process because the lack of co-evolved tolerance of resistant vegetation to new chemicals produced by the invader could allow these newly arrived species to dominant natural plant communities (Hierro, 2003).Allelopathy is a mechanism of plant interference by the addition of plant-produced phytotoxins to the plant environment.

Allelopathy can enhance the competitive success of the invader plants, since the release of phytotoxins in the environment may affect the growth and life processes of other community species (Callaway, 2002). Recently, it has been suggested that the establishement of species with strong allelopathic effects could be used as bio-intrusion barriers (Vyvyan, 2002 and Cooke and Johnson, 2002). Bhatt *et al*, (1994) reported that aqueous extracts of *Parthenium hysterophorus* and *Xanthium stromonium* adversely affected the radical extension of *Glycine max* and *Vigna mungo*. Allelopathic substances released by the plants accumulate in the soil to physiologicaly activity level (Hussain *et al*., 2004;and Samreen *et al*.,2009).

Results obtained from this present investigation on the effect of aqueous leaf extracts of *Tetona grandis* Linn.f. on seedling growth of *Vigna mungo* revealed that shoot and root length and leaf area increased in 5% leaf extract (Table-1). Shoot length ,root length and leaf area of *V.mungo* and *V.radiata* seedlings showed an increase in 5% leaf extract over control.As the concentration increased from 10%,25%,50% and 75% seedling growth also decreased concomitantly.A low percentage of shoot,root length and leaf area was observed in 100% leaf extract treatment.Among the different concentrations of the leaf extract the 5% extract alone showed a promotary effect while the other concentrations exhibited inhibitory effect on these parameters of both test crops. The reduction in seedling root and shoot length may be attributed to the reduced rate of cell division and cell elongation due to the presence of the allelochemicals (Javaid and Anjum, 2006). We reported similar stimulatory responses in previous research on juglone effects on the growth of coniferous seedlings (Funk et al., 1979).

This is generally accepted in the literature that phenolic compounds at low concentrations are stimulatory to germination and plant growth (Hegab *et al*., 2008; Gharieb *et al*., 2010;Manimegalai. Ei.al.,2012). Allelopathic effects of *C. album* on wheat (*T. aestivum*) with reduced germination (%), decreased shoot and root length (Daizy *et al*., 2006); However, later studies showed that (Jayakumar *et al.*,1987) The allelopathic extracts from teak leaves significantly inhibited germination and growth of *Lycopersicum esculentum, Solanum melongena* and *Capsicum annum* (Krishna *et al.*, 2003). Sahoo *et al.* (2007) have reported teak as a potential harmful allelopathic plant to maize. But the in length of shoot,root and leaf area decreased while increasing the concentration of *Tectona* dry leaf extract treatment on seedling growth. The allelopathic influence of *Eucalyptus sp.* has been significantly inhibited the germination speed, radical and plumule length of crops with increased concentrations of leaf extracts (Zhang, C. and fu, S.,2010) These results are partially in agreement with previous findings of Narwal and Sharma (1995) who reported that aqueous extract of wheat straw stimulated the germination and seedling growth of carpet weed (*Trianthema portulacstrum*), barnyard grass (*Echinocloa crusgalli*) and crowfoot grass (*Dactyloctenium aegyptium*) and inhibited that of pig weed (*Amaranthus spp*) and sunberry (*Physalis minima*) at higher concentration. Seedlings with 100% treatment shows very high reduction inhibition. Randhawa *et al.* (2002) reported that root length of *Trianthema portulacastrum* was affected by sorghum water extract and significantly reduced by high concentration of 75 and 100% sorghum water extract. These previous research strongly supports the present observation.Similar result obtained in *Vigna radiata* seedling treatments. But the rate of inhibition was higher than *V.mungo* seedlings. Turk and Tawaha (2003) found that aqueous extracts of black mustard (*Brassica nigra*) caused the reduction in germination, hypocotyl and radicle length of *Avena fatua*. Singh *et al.* (2005) also found a

strong positive correlation between extract concentration of residues of *Parthenium hysterophorus* and reduction in seedling length of *Brassica* species. Agarwal et al. (2002), Stavrianakou et al. (2004) also reported inhibition in the length of plumule and radicle, a reduction in their dry weights and total seedling weight in wheat, pea and lentil with water extracts of various weeds. Seedling growth significantly decreased by increasing the allelopathic concentrations. The reduction pattern in seedling growth was highly similar to root growth. The present study shows that both stimulatory (at lower concentration) and inhibitory (at higher concentrations) effects of fresh aqueous leaf extracts of *Tectona grandis* on growth of *V.mungo* and *V.radiata* were recorded. Like other parameters, seeds growth in the present study was found to be concentration dependent. Lower extract concentration had positive effects on seeds growth while higher concentrations corresponded to lower growth. The results showed that the leaf litter extracts of *Tectona* exerted allelopathic effects on seed growth of crop species. The inhibition increased with increasing concentration i.e. it was concentration dependent. The intensity of inhibition was directly proportional to the concentration of the extract employed.

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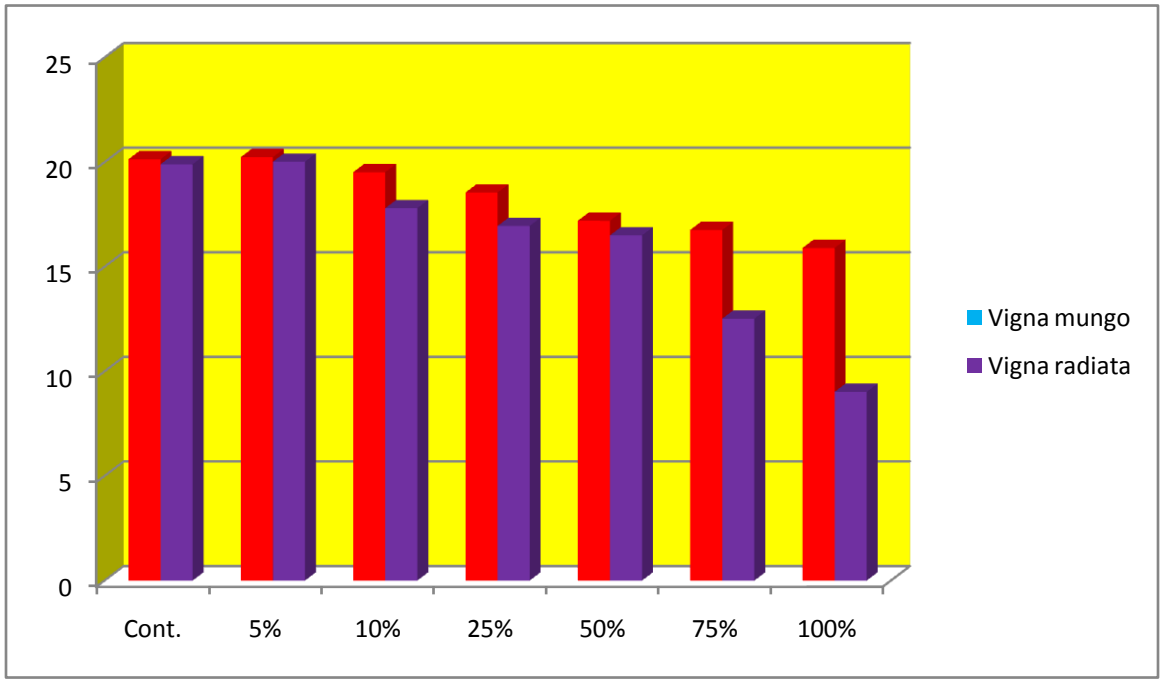
Table-1:The effect of aqueous leaf extract of Tectona grandis on seedling growth(µg/g) of Vigna mungo and Vigna radiate

Conc. of Extract %	*Vigna mungo*			*Vigna radiate*		
	Shoot length	**Root length**	**Leaf Area**	**Shoot length**	**Root length**	**Leaf Area**
Cont	20.14 (±1.00)	5.22(±0.26)	3.80(±0.19)	19.90(±0.99)	4.84(±0.24)	2.81(±0.14)
5	20.24 (±**1.01**)	6.34(±**0.31**)	4.02(±**0.20**)	20.02(±1.00)	4.68(±0.23)	3.61(±0.18)
10	19.52(±0.97)	5.01(±0.25)	3.07(±0.15)	17.80(±0.89)	4.04(±0.20)	2.50(±0.12)
25	18.55(±0.92)	4.94(±0.24)	2.93(±0.14)	16.95(±0.84)	3.08(±0.15)	2.32(±0.11)
50	17.20(±0.86)	4.58(±0.22)	2.12(±0.10)	16.50(±0.82)	2.70(±0.13)	1.82(±0.09)
75	16.76(±0.83)	3.05(±0.15)	2.20(±0.11)	12.52(±0.62)	1.36(±0.06)	0.26(±0.01)
100	15.90(±0.79)	2.64(±0.13)	0.44(±0.02)	9.02(±0.45)	0.90(±0.04)	0.19(±0.00)

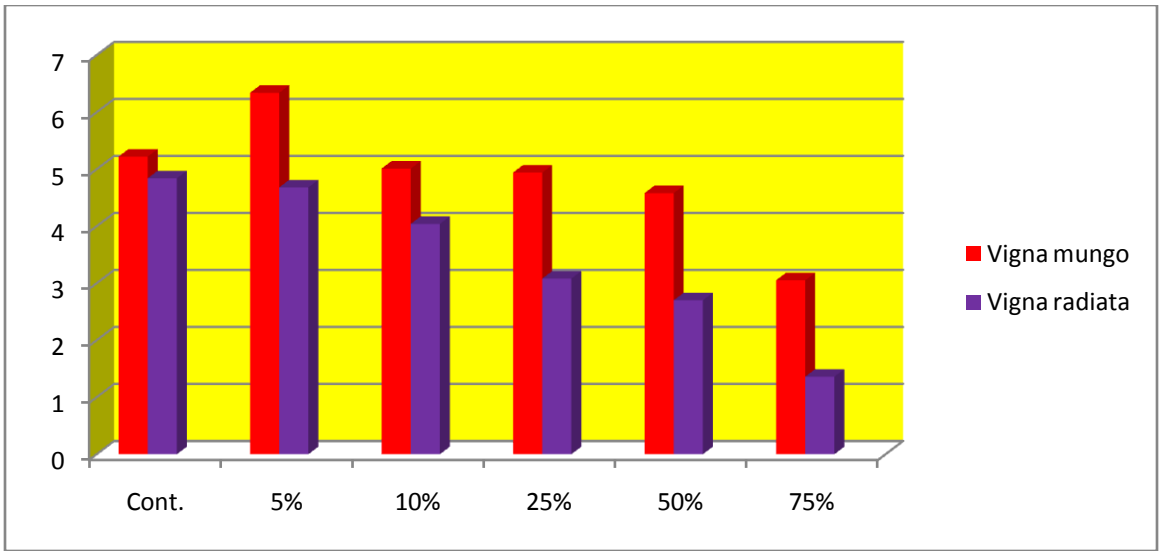
Graph-1:Shoot Length

Conc.of Extract %	Shoot Length	
	Vigna mungo	*Vigna radiata*
Cont.	20.14	19.90
5	20.24	20.02
10	19.52	17.80
25	18.55	16.95
50	17.20	16.50
75	16.76	12.52
100	15.90	9.02



Graph-2:Root Length

Conc.of Extract %	**Root Length**	
	Vigna mungo	*Vigna radiata*
Cont.	5.22	4.84
5%	6.34	4.68
10%	5.01	4.04
25%	4.94	3.08
50%	4.58	2.70
75%	3.05	1.36
100%	2.64	0.90



Graph-3:Leaf Area

Conc.of Extract %	Leaf Area	
	Vigna mungo	*Vigna radiata*
Cont.	3.80	2.81
5	4.02	3.61
10	3.07	2.50
25	2.93	2.32
50	2.12	1.82
75	2.20	0.26
100	0.44	0.19